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APPLICATION FOR UNITED STATES LETTERS PATENT

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

Be it known that I, **Sang Woo NAM**, a citizen of the Republic of Korea, residing at 891-10 Daechi-dong, Gangnam-gu, Seoul, Korea have invented a new and useful **INORGANIC COMPOUND FOR REMOVING POLYMERS IN SEMICONDUCTOR PROCESSES**, of which the following is a specification.

INORGANIC COMPOUND FOR REMOVING POLYMERS IN SEMICONDUCTOR PROCESSES

FIELD OF THE DISCLOSURE

[0001] The present disclosure relates generally to semiconductor devices and, more particularly, to an inorganic compound for removing polymers after a semiconductor etching process.

BACKGROUND

[0002] In general, polymers are generated from a photoresist mask, during dry etching processes such as a metal line etching process, a via hole etching process and a pad oxide film etching process. In order to remove the polymers generated during the dry etching processes, amine-based chemicals and ammonium fluoride-based chemicals have been widely used as a solvent. After removing the polymers with the solvent, the solvent is treated with, e.g., isopropyl alcohol ("IPA") and methanol and eliminated by a rinsing process using deionized water ("DIW").

[0003] However, such a conventional polymer removing process is complicated, and the equipment needed to perform such a conventional polymer removing process is complex because the solvent for removing the polymers should be maintained at a high temperature.

[0004] In addition, the solvent is an expensive organic compound and the used solvent is typically gathered to be burned up in a separate waste treatment process, thereby increasing the maintenance costs associated therewith. Further, it takes an extended time to complete the rinsing process, so that a galvanic corrosion may be caused on semiconductor elements.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Fig. 1 is a block diagram illustrating an example apparatus for manufacturing a compound for removing polymers.

DETAILED DESCRIPTION

[0006] In one example embodiment, there is provided a compound for removing polymers generated during etching process, including DIW, H_2SO_4, H_2O_2 and HF, which are inorganic chemicals.

[0007] In another example, there is provided a method for removing polymers generated during etching processes, including removing the polymers by using an inorganic compound including DIW, H_2SO_4, H_2O_2 and HF, forming a protective oxide film on a metal line, a via hole or a pad open area by using H_2O_2, and protecting the metal line, the via hole or the pad open area by the protective oxide film while removing the polymers by using HF.

[0008] In still another example, there is provided an apparatus for manufacturing a compound for removing polymers generated during etching processes includes tanks in which DIW, H_2SO_4, H_2O_2 and HF are stored, respectively, a main tank for mixing DIW, H_2SO_4, H_2O_2 and HF supplied from the respective tanks through supplying tubes respectively connected between the main tank and the tanks, flow control devices for controlling flow rates of DIW, H_2SO_4, H_2O_2 and HF, which are respectively installed to the supplying tubes, and a pump for circulating a mixture of DIW, H_2SO_4, H_2O_2 and HF stored in the main tank in order to make the mixture uniform.

[0009] As shown in Fig. 1, an example apparatus for manufacturing an inorganic compound for removing polymers includes a first, a second, a third and a fourth tank

100a, 100b, 100c and 100d in which DIW, H_2SO_4, H_2O_2 and HF are stored, respectively, a main tank 104 for mixing DIW, H_2SO_4, H_2O_2 and HF supplied through supplying tubes connected with the first, the second, the third and the fourth tank 100a, 100b, 100c and 100d, respectively, flow control devices 102a, 102b, 102c and 102d installed to the supplying tubes for controlling flow rates of DIW, H_2SO_4, H_2O_2 and HF supplied to the main tank 104, respectively, and a pump 106 for circulating the mixture of DIW, H_2SO_4, H_2O_2 and HF to be uniformly mixed.

[0010] The compound produced by such an apparatus is used to remove polymers generated while a metal line, a via hole, a pad open area and the like are formed by an etching process using a photoresist as a mask. Further, the compound serves to remove the photoresist residual.

[0011] The polymer removing compound may be manufactured using the example method described below.

[0012] DIW, H_2SO_4, H_2O_2 and HF are supplied to the main tank 104 by controlling the respective flow control devices 102a, 102b, 102c and 102d of the respective supplying tubes connected between each of the first, the second, the third and the fourth tank 100a, 100b, 100c and 100d and the main tank 104. DIW supplied from the first tank 100a to the main tank occupies by volume about 70.5% to about 80.5%, preferably 75.5%, of the total volume of DIW, H_2SO_4, H_2O_2 and HF being supplied to the main tank 104. At this time, the volume of DIW is controlled by the flow control device 102a installed to the supplying tube connected between the first tank 100a and the main tank 104.

[0013] H_2SO_4 supplied from the second tank 100b to the main tank occupies by volume about 6.5% to about 8.5%, preferably 7.5%, of the total volume of DIW, H_2SO_4, H_2O_2 and HF being supplied to the main tank 104. At this time, the volume of

H_2SO_4 is controlled by the flow control device 102b installed to the supplying tube connected between the second tank 100b and the main tank 104.

[0014] H_2O_2 supplied from the third tank 100c to the main tank occupies by volume about 15% to about 19%, preferably 17%, of the total volume of DIW, H_2SO_4, H_2O_2 and HF being supplied to the main tank 104. At this time, the volume of H_2O_2 is controlled by the flow control device 102c installed to the supplying tube connected between the third tank 100c and the main tank 104.

[0015] HF provided from the fourth tank 100d to the main tank occupies by volume about 50 PPM to about 150 PPM. At this time, the volume of HF is controlled by the flow control device 102d installed to the supplying tube connected between the fourth tank 100d and the main tank 104.

[0016] By such processes, by volume, DIW of about 70.5% to about 80.5%, H_2SO_4 of about 6.5% to about 8.5%, H_2O_2 of about 15% to about 19% and HF of about 50 PPM to about 150 PPM are stored in the main tank 104. DIW, H_2SO_4, H_2O_2 and HF are circulated by the pump 106 to be uniformly mixed.

[0017] The compound produced by such processes can be used to remove polymers generated during the etching processes. Further, the compound also serves to remove the photoresist residual. In particular, H_2SO_4 and H_2O_2 of the compound serve to remove the photoresist residual. H_2O_2 also forms a protective oxide film on the metal line, the via hole and the pad open area to protect them from corrosion while HF removes polymers.

[0018] The compound for removing polymers is made of the inorganic chemicals, such as DIW, H_2SO_4, H_2O_2 and HF, thereby shortening the time period of a rinsing process after the removal of polymers.

[0019] In accordance with the example methods described herein, the polymers are removed by using the inorganic compound, thereby shortening the time period of the rinsing process after the removal of polymers and preventing any galvanic corrosion of the semiconductor elements, e.g., the metal line, a miss-aligned plug, the pad open area due to the shortened rinsing process time. Further, the compound is made of the cheaper inorganic chemicals, thereby decreasing the maintenance cost.

[0020] Although certain methods and apparatus have been described herein, the scope of coverage of this patent is not limited thereto. To the contrary, this patent covers all embodiments fairly falling within the scope of the appended claims either literally or under the doctrine of equivalents.